The A, B, C's of PCMCIA and FlashDisk

Q

What is PCMCIA?

A

PCMCIA is a technical design standard and an international industry trade association.

The Personal Computer Memory Card International Association (PCMCIA) is a non-profit trade association established in June of 1989 and headquartered in Sunnyvale, California. The organization's charter is to establish, market and maintain a standard for PC Cards. PCMCIA membership has grown from a handful of charter members in 1989, such as SanDisk, Fujitsu and Lotus, to include more than 500 companies ranging from computer manufacturers such as Apple, IBM and Toshiba to consumer electronics companies such as AT&T, Kodak and Polaroid to software companies such as Lotus, Microsoft and Novell.

The PCMCIA interface is a series of hardware and software standards for PC Cards. These credit-card sized devices can expand the memory, storage, I/O and eventually, the processing capabilities of host machines. A host machine can be any computer-based device including notebooks, palmtops, desktop PCs, personal communicators, laser printers, digital cameras, fax machines, test equipment and medical imaging equipment.

Q

What is PCMCIA's goal?

A

PCMCIA's goal is to develop standards and promote worldwide adoption of PCMCIA-based products. This will promote interoperability and upgradability among the rapidly growing range of PC Cards and PC Card-based systems. Interoperability and upgradability lowers the investment that hardware makers, software developers and end-users need to make to benefit from the PCMCIA standard.

Q

Why is PCMCIA necessary? Aren't there enough standards already?

A

Prior to PCMCIA there was no worldwide or industry-wide standard for consumers to easily install additional memory, mass storage, LAN cards or other types of expansion products to notebooks, palmtops and other mobile computers. Docking stations that could accept conventional expansion products were inherently expensive and, due to their size, impractical to take on the road. Leading notebook manufacturers saw this limitation as a serious obstacle to the growth of the mobile computing market and pushed aggressively for the development of an international standard. Additionally, most earlier expansion product standards were specific to a particular host computer microprocessor bus architecture whereas PCMCIA addresses a wide variety of expansion products and architectures.

Q

Is PCMCIA a hardware or software standard?

A

The PCMCIA standard covers both hardware and software. In addition to the many peripheral and systems manufacturers that have worked to develop the standard, the PCMCIA standard has been developed and is supported by many application, operating system and BIOS/system software developers.

Q

What computing environments does the PCMCIA standard address?

A

The PCMCIA standard addresses the requirements of today's office computing and mobile computing environments as well as numerous industrial and military computing applications. The standard also addresses the need for removable and user installable upgrades for a wide variety of computing environments.

Q

What is a PC Card?

A

A PC Card is a peripheral device that can add a wide variety of capabilities to computers including system memory, mass-storage, LAN, fax/modem and wireless communications. The PCMCIA standardized PC Card is roughly the dimensions of a thick credit card and has a 68-pin connector at one end.

PCMCIA adopted the existing 68-pin credit card form factor defined in 1985 by JEIDA. PCMCIA together with JEIDA refined this physical specification and added definitions for connector pin assignments, electrical characteristics, hardware/software protocols and file formats.

Q

What is JEIDA?

A

JEIDA (Japan Electronic Industry Development Association) is a sister organization to PCMCIA and has been responsible for the definition and publication of a variety of Japanese industry standards. Together, JEIDA and PCMCIA have made the PCMCIA standard a worldwide standard.

Q

What is JEIDA's relationship with PCMCIA?

A

JEIDA and PCMCIA have cooperated extensively, attending each other's meetings and exchanging information on new specifications as they are developed. As a result, JEIDA 4.0 is equivalent to PCMCIA 1.0 and JEIDA 4.1 is equivalent to PCMCIA 2.0. The two organizations continue to work together to ensure worldwide standards that support rapid market growth.

PCMCIA has also worked closely with other international standard-setting bodies including EIA/JEDEC (Electronics Industry Association/Joint Electron Device Engineering Council) and ISO (International Standards Organization).

Q

What does the PC Card Logo mean?

A

The PC Card Logo indicates the company is a member of the PCMCIA Association and that PC Card technology is present in the product which displays the logo.

Q

How easy are PC Cards to use?

A

PC Cards are inserted similar to floppy diskettes. One of the goals of PCMCIA is to make the technology as user friendly as possible. Many host systems have been designed to allow for this plug-and-play capability, meaning that you can insert a PC Card while the system is powered on and begin using its capabilities immediately.

Q

What is the difference between the different "Types" of PCMCIA PC Cards?

A

To allow manufacturers to add functions and technologies in the PC Card form factor, PCMCIA has defined three PC Card types. Type I, II and III cards all look like credit cards from the top, with the same length and width, but with different thicknesses. All three have a 3.3 mm thick guide rail around their edges and connector ends, but Type II and III cards have bubbles or canopies that are 5 mm (equal to a stack of about 6 credit cards) and 10.5 mm thick respectively. The guide rails allow the thinner cards to be installed in thicker slots (e.g. Type II cards fit in Type II and III slots, Type I cards fit in any Type slot).

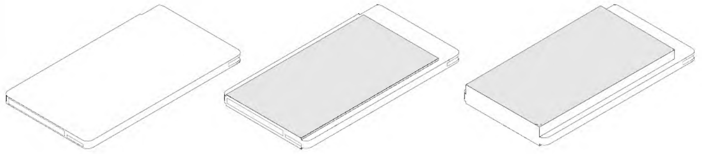
A Type I PC Card is 3.3 mm thick and is commonly used for system memory products. Type II PC Cards are 5 mm thick to accommodate applications that require slightly more room for components such as flash cards, fax/modem and network cards. Type III PC Cards are 10.5 mm thick to accommodate high-functionality products such as rotating disk drives and wireless communication devices. It is important to note that although a Type IV card was previously considered by the PCMCIA Association for inclusion in the PCMCIA standard, it was decided not to include such a product definition in the standard at this time.

Q

What do the three Types of cards look like?

A

The three PCMCIA Types are illustrated below:



Type I	Type II	Type III
3.3 mm	5.0 mm	10.5 mm

Q

What are Extended Cards?

A

Extended Cards are PCMCIA recommended extensions to the PCMCIA Type I & II card types. The extended cards are identical to regular PC Cards with the exception of their length; the extended cards are up to 50 mm longer than regular PC Cards. Extended cards are primarily used for applications that need components outside of the systems or require PC Cards with thicker bodies than the existing PCMCIA socket supports.

Q

What are the differences between PCMCIA Releases 1.0, 2.0, 2.01 and 2.1?

A

Release 1.0, issued in September 1990, set the specification for a PC Card offering memory capabilities for mobile computing. Release 2.0 issued in September 1991, broadens the specification with the addition of I/O (Input/Output) and XIP (Execute In Place) capabilities, allowing for mass storage, modem, LAN, cellular and radio frequency communications peripherals. Release 2.01 is the typographical correction of Release 2.0 with the addition of new sections addressing PC Card ATA, AIMS, Card Services, Socket Services and Recommended Extensions. Release 2.1 is the latest release of the PCMCIA standard. This release contains additional specifications in the area of Card and Socket Services as well as general editorial and typographical changes.

Q

What are some of the characteristics of the PCMCIA standard that make it so attractive?

A

The PCMCIA interface has been rapidly accepted as the interface of choice by mobile computer manufacturers and users. In many ways, the unique features of PCMCIA Release 2 make PCMCIA compliant host computers easier to use and more expandable than today's desktop PCs. The key features of the standard are:

- Host Independence
- User Installable Options
- Small Size
- High Performance
- Hot Swapping
- Removability
- Compatibility and Interoperability
- Low Power Requirements

Q

What is Host Independence and why is it important?

A

PC Cards are designed to run with any host machine that has a PCMCIA slot, regardless of the host system's microprocessor or operating system. A PC Card can be designed so that it will function in an IBM PC compatible notebook, an Apple Newton palmtop, a Pen-based work slate, an AT&T Personal Communicator or a PCMCIA compliant piece of test equipment. This flexibility is not mandatory and different software may be required for the PC Card to operate on different host systems, but the growing acceptance of the PCMCIA standard will generate an increasing demand for PC Cards that will run on a wide variety of host systems.

Q

Why is User Installability important?

A

PC Cards are designed to be easy for anyone to install. Computer users can add flash mass storage or a LAN adapter in a few seconds, or about the length of time it takes to insert a bank card into an automatic teller machine. It's easy to overlook the importance of this installability, but its significance becomes more apparent if you consider the effort required to install an expansion card in a desktop PC.

By defining an easy installation scheme, PCMCIA has paved the way for an explosive market for PCMCIA compatible PC Cards. Easy insertion and expansion are two reasons why many industry leaders believe that PCMCIA slots will soon become common in all classes and types of computing devices, even desktop PCs and workstations.

Q

Why is Small Size important?

A

The ideal peripheral product size for a mobile computer user is a credit card. It is small enough to fit in a pocket but big enough not to be easily lost. Everyone is accustomed to using them with confidence, to inserting them in a variety of slots and to carrying a collection of them to accomplish their goals.

Q

Why is High Performance important?

A

Today's mobile computer users demand high performance just like their desktop PC counterparts. PCMCIA Release 1.0, published in September 1990, was designed to support add-in memory cards only. This required a tight coupling of the host system's internal bus structure combined with an external interface with a high performance bandwidth. PCMCIA Release 2.0, published in September 1991, added an I/O and interrupt structure that allowed PC Cards to be used as high-speed I/O devices such as LAN adapters, 1.8" disk drives and modems.

Q

What is Hot Swapping and why is it important?

A

PCMCIA defines a hardware and software protocol whereby PC Cards can easily be interchanged while the host system's power is on. This allows users of systems with PCMCIA slots to easily configure their system to be equipped with the number and Type of PC Cards they require without having to turn the host system's power off or reboot the host system. In addition to saving time, this adds to the total expandability of a mobile computer.

Q

Why is Removability important?

A

Since many mobile computers have a limited number of slots, the ability to use a variety of PC Cards in the same slot allows users to configure their systems to meet their unique requirements. The PCMCIA standard recognizes and takes advantage of the fact that users don't need a fax card when they're not sending or receiving a fax or they don't need a LAN adapter when they are not working over a network.

Additionally, a PCMCIA slot allows users to easily transport their valuable data from one computing platform to another by using removable, high performance, high capacity FlashDisks or rotating disk drive storage options. These removable storage options have all the benefits of floppy diskettes and rotating disk drives combined in one credit card size PC Card.

Q

What are Compatibility and Interoperability?

A

The primary goal of PCMCIA is to ensure full compatibility and interoperability among PCMCIA compliant host systems, thereby allowing users to use their PC Cards on or between various host systems that have PCMCIA slots. This goal is rapidly becoming reality with the completion and implementation of the Card and Socket Services portion of the PCMCIA standard. Compatibility is made possible by PC Card and host system manufacturers conforming to the PCMCIA standards. In PC Cards and host systems where this is implemented, interoperability or the ability to use a single PC Card on a number of different host systems is then possible. PC Card ATA is an excellent example of how compatibility and interoperability are achieved. The PC Card ATA standard makes it possible for a user to move their mass storage (Flash card or rotating disk drive) device between different host systems, each of which may use a different microprocessor or operating system than the next.

Q

What is Low Power and why is it important?

A

With the advent of palmtops and Personal Digital Assistants (PDAs), users have become highly mobile and use their computers in environments where use of standard AC power may not be convenient, accessible or feasible. Because of these demands, today's mobile computers are being designed to use low cost disposable batteries as their power source. A few popular examples of this are the HP 95 & 100LX, the HP OmniBook 300 & 425 and the Tandy Zoomer, all of which use AA batteries to power the system. These new systems require low power consumption expansion products, like flash mass storage, to meet the battery life demands of today's mobile users.

Q

When will the PCMCIA standard gain commercial acceptance?

A

It already has. Virtually every computer manufacturer is either already shipping today or has announced plans to ship a PCMCIA compatible desktop, notebook, subnotebook or PDA class of computer. Additionally, numerous peripheral manufacturers have announced and are shipping a wide variety of expansion products.

Q

Why is PCMCIA so important?

A

From a marketing standpoint, PCMCIA is important because it rides the wave of miniaturization that is sweeping over the computer industry. Growth of the hand held computer market is expected to exceed 100% per year through 1995. The notebook computer market is expected to grow at the rate of 25% per year through 1995. Lempesis Research estimates that over half of all U.S. PC shipments in 1995 will be laptop, notebook, or pen computers. In contrast, unit growth in the desktop market is expected to decline.

As the de facto standard interface for mobile computers, PCMCIA is likely to become as important as IBM's XT/AT bus, which has been the dominant internal bus standard for over a decade.

Q

Will PCMCIA replace the XT/AT bus?

A

The XT/AT bus is an internal memory and I/O bus whereas PCMCIA is an external memory and I/O interface. Both buses have about the same bandwidth and portions of the XT/AT bus structure are used internally in small mobile computers. However, existing XT/AT bus expansion cards are too large to fit in this new class of host systems. Additionally, because the PCMCIA standard makes it easy for users to add and swap expansion products, desktop PC vendors such as HP and IBM are now offering PCMCIA slots in their systems. Therefore, some XT/AT compatible PC cards may be displaced by PCMCIA cards, but the XT/AT bus itself will probably dominate desktop PCs for years to come.

Q

What can be expected from PCMCIA in the near future?

A

PCMCIA is not expecting to add any additional form factors, such as a Type IV card, or to allow major changes in card sizes or dimensions. Instead, future standards will enhance and extend the framework established in Release 2 with such added capabilities as DMA, 3.3 volt and 32 bit operation. Future standards are also being developed in function specific areas for products such as modem, LAN and SCSI bus expansion cards, etc.

Q

What is the status of the 3.3 Volt standard?

A

PCMCIA recognizes that a 3.3 volt-only system is very important. Release 2.01 currently allows a system to drop down from 5.0 volts to 3.3 volts if the system deems that acceptable. A 3.3 volt only solution was adopted by the PCMCIA technical committee in September, 1993. The publication of the 3.3/5.0 volt specification is expected in early 1995.

Q

What is the status of the 32-bit standard?

A

The PCMCIA CardBus sub-committee is in the process of developing a specification to extend the functionality of the PCMCIA standard to 32-bit operation. The sub-committee's primary goal is to define a 32-bit superset interface with support for multiple Bus Masters and Slaves.

Q

What makes up the PC Card architecture?

A

The PC Card architecture or PCMCIA standard is divided into the following six layers:

- Card Hardware
- Card Metaformat
- Socket Hardware
- Socket Services
- Card Services
- Clients

Q

What is the Card Hardware layer of the PCMCIA architecture?

A

The Card Hardware layer of the PC Card standard defines the physical size, ruggedness, mechanical characteristics and the electrical aspects including signals, registers and card specific functions of the PC Cards themselves.

Q

What is the Card Metaformat layer of the PCMCIA architecture?

A

The Card Metaformat layer is a PC Card description language used to describe the PC Card's characteristics and options. It is contained in memory on the PC Card and the descriptive data is referred to as the "Card Information Structure" or C.I.S. This information is read by the Card Services and Client layers of the PCMCIA architecture to assist them in selecting and configuring a PC Card and socket for a particular application.

Q

What is the Socket Hardware layer of the PC Card architecture?

A

The Socket Hardware layer of the PC Card standard defines the physical, mechanical and electrical characteristics of the PCMCIA slots themselves. Socket Services provides software control for the Socket Hardware layer.

Q

What is Socket Services?

A

Socket Services is the lowest layer of host software in the multi-level scheme defined by PCMCIA. Socket Services is the hardware dependent software, possibly resident in the host system's BIOS, that provides a standard method of accessing and controlling the PCMCIA slots of a computer. It connects a PCMCIA host controller to higher services such as Card Services or if Card Services is not present, directly to device drivers. Socket Services reports how many sockets it is controlling in the host computer system and detects the insertion or removal of a PC Card.

Socket Services is used to provide a single software interface for a variety of socket hardware implementations. Each socket manufacturer such as Cirrus, Databook, Intel or Vadem have a unique version of Socket Services for each type of socket adapter they produce. Socket Services may need further customization when a socket adapter is used in a platform with enhancements or restrictions of the adapter's functionality. BIOS writers, such as AMI, Award, DataBook, Go Penpoint, Phoenix, SystemSoft and Vadem are currently working to incorporate Socket Services into the host system's BIOS or as an installable device driver to provide an integrated solution for PCMCIA compatible computers.

Q

What is Card Services?

A

Card Services is the hardware independent layer of host system software that resides between Clients and Socket Services. Card Services' Clients include device drivers and/or application software which make use of PCMCIA and host system resources such as memory, I/O addresses and interrupts. Card Services is a software management interface that coordinates the Clients' allocation and release of host system resources. Card Services notifies Clients of events such as card insertion or removal after Socket Services notifies it of the events.

Q

What are Clients?

A

Clients can be device drivers, utility programs, application software or Memory Technology Drivers (MTDs). Several Clients can be loaded into the host computer system at the same time. The Clients call various Card Services routines that control the socket hardware in order to configure and gain access to the actual PC Cards. When a PC Card is made accessible in the Client's memory or I/O space, the Client usually accesses the Card directly to perform the functions the user requests.

Memory Technology Drivers are a device specific type of Client that is required in addition to the bulk memory driver Client for technology dependent flash cards like those manufactured by Intel and AMD. A different Memory Technology Driver is required by the host system for each one of these different flash vendors (e.g. Intel, AMD) as well as for each different density (e.g. 4 Mbit, 8 Mbit) of flash the user wishes to access.

PC Card ATA mass storage devices, such as FlashDisks from SanDisk, Seagate and Verbatim and rotating disk drives from Seagate, Maxtor and others, use the industry standard PC Card ATA interface and therefore do not require Memory Technology drivers.

Q

Who provides all these different layers that define the standard?

A

System software and BIOS vendors work in unison with socket adapter board and PC Card manufacturers to provide the Card Services, Socket Services, MTDs and Client specific device driver routines necessary to define the multi-layered software approach PCMCIA requires. The various software layers are either bundled with the host system as installable device drivers or reside in the host system's BIOS and in both instances are indistinguishable to the user. Together all of the software layers work in unison to provide the unique features and benefits of the PCMCIA standard.

Q

Why use all these different layers?

A

This layered approach provides an isolated, structured and universal means for different software packages to access different combinations of adapter boards and systems thereby creating a universal standard for host system manufacturers to follow.

Q

Do all host systems and PC Cards follow this structure?

A

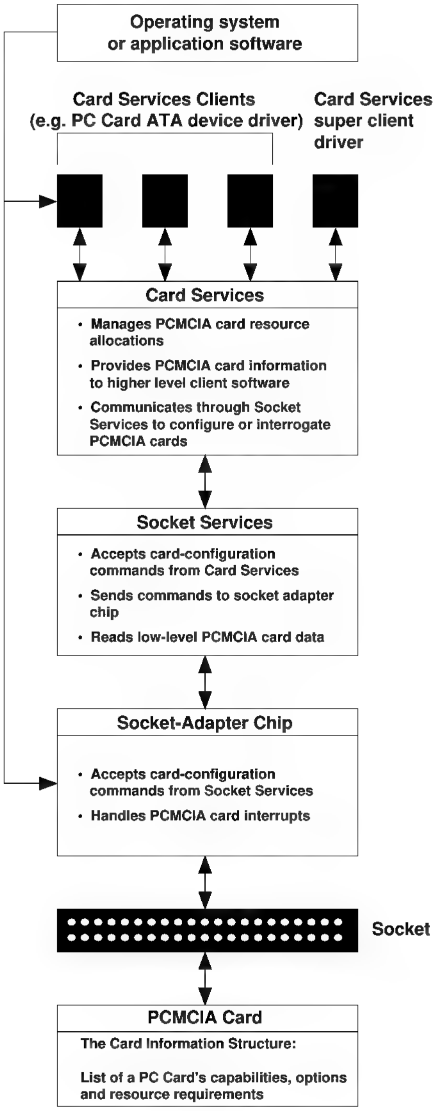
Unfortunately not all host systems or PC Cards fully adhere to this structure. This is especially true for systems and PC Cards that were designed before the publication of Release 2.01 of the PCMCIA standard in November, 1992. In these systems and PC Cards the manufacturers typically provided device drivers that were platform and PC Card specific. This allowed the manufacturer's device driver to bypass the various software layers the PCMCIA standard defines and gain direct access to the PC Card.

These systems can provide excellent support for the combination of PC Cards for which they were designed to support, but have limited ability to support PC Cards which were not originally envisioned being used by the host system. Many of these products have either been upgraded to fully incorporate the PCMCIA standard architecture or discontinued as their manufacturers introduced new versions of the product that fully comply with the PCMCIA standard. Owners of such products should contact the manufacturer of the product they own regarding available upgrades.

Q

What does a block diagram look like of all these different layers?

A


Operating system
or application software
Card Services Clients
(e.g. PC Card ATA device driver)
Card Services
super client
driver
Card Services
• Manages PCMCIA card resource allocations
• Provides PCMCIA card information to higher level client software
• Communicates through Socket Services to configure or interrogate PCMCIA cards
Socket Services
• Accepts card-configuration commands from Card Services
• Sends commands to socket adapter chip
• Reads low-level PCMCIA card data
Socket-Adapter Chip
• Accepts card-configuration commands from Socket Services
• Handles PCMCIA card interrupts
Socket
PCMCIA Card
The Card Information Structure:
List of a PC Card's capabilities, options and resource requirements

Q

What is Execute in Place (XIP)?

A

In some cases, software can be placed on PCMCIA compatible memory cards to execute directly from the card itself without requiring that the program first be loaded into the host system's memory. The primary advantages of XIP are: (1) a reduction in the amount of internal memory required for host machines and (2) a difficult to pirate means for software publishers to distribute their programs. On the other hand, the disadvantages of XIP are: (1) if a memory card is removed while in use it may crash or hang the host system (2) XIP is typically slower than running the software from the host system's memory (3) application software must be rewritten to run in XIP mode and (4) XIP is typically implemented differently by different vendors and in many cases is platform specific.

Q

What is PC Card ATA (a.k.a. PCMCIA ATA) and why is it important?

A

PC Card ATA is a PCMCIA standard that specifically addresses mass storage products. It combines the industry standard AT disk drive command set, registers and protocol with the PCMCIA interface registers and protocols. Together these standards define the PC Card ATA standard which is a technology independent interface. This means that today's PC Card ATA products, such as SanDisk FlashDisk, will work in tomorrow's systems and today's systems will work with tomorrow's PC Card ATA products. Since virtually all major operating system software vendors (Geoworks, IBM, Microsoft), hardware vendors (AST, Compaq, Dell, HP, IBM, Packard Bell, etc.) and storage vendors (SanDisk, Connor, IBM, Maxtor, Seagate) support the PC Card ATA standard, mobile computer users will have access to a wide variety of computer products and peripherals to meet all their computing needs.

Q

Can you boot from a PC Card ATA Card?

A

Some host system implementations allow PC Card ATA Cards to be bootable. Check the User's Guide that came with the host system to see if this important feature is supported.

Q

What System Software companies have built-in PC Card ATA support?

A

The following chart outlines the various system software firms which have built-in PC Card ATA support. Since the product names and version numbers are updated frequently, we suggest you contact the system BIOS vendors directly to obtain the most up-to-date information.

System BIOS Vendor	Product Name	Phone Number
AMI	AMICARDZ	404-263-8181
Award/VMI	Cardware	415-968-4433
Databook	Card Talk for Databook Chip	607-277-4817
Phoenix	Phoenix Card Manager Plus	714-440-8000
SystemSoft	Card Soft	508-651-0088
Vadem	Socket Services for VG365, VG465, VG468	408-943-9301

Q

What is Flash mass storage?

A

Flash or solid-state mass storage uses Flash semiconductor chip technology to store data much like a rotating disk drive uses a platter to store data. Flash is the lowest cost, non-volatile semiconductor read/write storage technology available today. The non-volatile feature means that data is retained indefinitely without any requirement for power, AC or battery, being supplied to the storage device.

Q

What is the difference between Static RAM (SRAM) and Flash?

A

SRAM is a volatile semiconductor technology. Therefore, power must continuously be supplied to the device by either the host system or by an internal battery in the SRAM card or the data will be lost. Because of their design, SRAM cards are typically sold in 1 to 4 MB capacities today. On the other hand, flash cards do not require a built-in battery and are available in capacities as large as 40 MB today and is substantially less expensive per megabyte than SRAM.

Q

What are the advantages of Flash mass storage?

A

Flash mass storage devices have several advantages over other storage devices. Flash mass storage devices are noiseless, considerably lighter, faster, consume less battery power and are much more rugged than rotating disk drives. PCMCIA flash cards are able to withstand more than 1000 g's of operating shock or the equivalent of someone dropping a flash card 8 feet to the floor.

Q

Who is SanDisk and what makes SanDisk a leader in Flash mass storage systems?

A

SanDisk, founded in 1988, is a privately held company based in Santa Clara, California. The company designs, manufactures and markets solid-state mass storage system based on SanDisk's proprietary Flash memory technology. By optimizing its Flash memory design for mass storage systems rather than as a strict EPROM replacements, SanDisk has achieved substantial density, reliability, compatibility and cost advantages over its competition. The company holds numerous patents on its semiconductor Flash memory, packaging technology and sophisticated proprietary controller architecture. SanDisk has been delivering its products in high volume to a variety of customers ranging from major computer manufacturers to global distributors since 1991.

Q

What Flash mass storage products does SanDisk offer?

A

SanDisk offers a family of products for portable computing featuring two industry standard interfaces: IDE (Integrated Drive Electronics) and PC Card ATA.

The SanDisk IDE FlashDrive Series was designed to operate as "Plug-n-Play" replacements for 1.8-inch and 1.3-inch IDE hard disk drives. With their integrated controllers and their 100% IDE (PC/XT or PC/AT) compatibility, these products can be deployed as a hard disk drive replacement in any system which supports the IDE interface.

The controller and data management technology of the FlashDrives is also used in the SanDisk PCMCIA family of PC Cards (FlashDisks) and the CompactFlash Series. The SanDisk PCMCIA FlashDisk Series and CompactFlash Series will work in nearly any computer designed today which has a PCMCIA compliant Type II or Type III slot. The PCMCIA FlashDisk Series consists of Type II PC Card ATA cards with capacities from 1.8 to 40 MB, and Type III PC Card ATA cards with capacities from 80 to 175 MB. The Type II cards will fit both type II and Type III slots.

The CompactFlash Series is a new mass storage technology that enables a new generation of extremely small form factor mobile electronic products. CompactFlash provides full PC Card ATA compatibility yet the CompactFlash cartridge weighs only a half ounce and is the size of a postage stamp, one-fourth the size (in volume) of a standard PCMCIA Type II card. CompactFlash has built-in, industry-standard connectivity because the 50-pin CompactFlash cartridge can be slipped into a passive 68-pin adapter that fully meets PCMCIA electrical and Type II mechanical standards. The CompactFlash PC card adapter, which SanDisk offers with the CompactFlash cartridge, can be inserted into thousands of platforms that already have industry-standard Type II or Type III PC Card ATA slots. CompactFlash adds significant functionally to existing consumer electronics products and enables these products to be smaller, lighter and less expensive.

Q

How do SanDisk products operate?

A

SanDisk solid-state Flash drives appear to the host computer as a hard disk drive, operating with much better performance, reliability, ruggedness and power requirements than traditional mechanical drives.

In an MS-DOS environment, a system will recognize the SanDisk solid-state Flash drive much like an IDE hard disk drive and assign it a logical drive (e.g. D:). All MS-DOS applications and utilities can be used with SanDisk drives.

Q

Are there different types of Flash?

A

Yes, there are two basic types of Flash memory. The first is called block erase or socket flash because it was designed to replace EPROM technology and is typically sold in a chip form. This type of technology has a minimum write/erase block size much larger than the typical 512 byte file system block size. Block sizes of 64 Kbytes or more are very common. The second type of Flash was designed by SanDisk to be used specifically as a mass storage device and a disk drive look alike. The SanDisk Flash technology has a write/erase block size of 512 bytes of user data just like a rotating disk drive and is 100% DOS compatible.

Q

What's the difference between SanDisk FlashDisk technology and other vendor's Flash Memory cards?

A

Most flash memory card vendors (e.g. Intel, AMD) use a flash card design that contains an array of flash memory and interface chips but no intelligent controller to manage the flash media. The burden for management of the flash media is placed on the CPU of the host computer, using one of the various software Flash File Systems provided by Microsoft, M-Systems or SCM. In other words, the performance of most flash memory cards is very dependent on host processor speed. Additionally, the performance of these cards degrades with card usage, i.e., as the amount of data stored on the card increases, the performance of the card slows down. This performance degradation is directly related to the Flash File System architecture. SanDisk's Flash cards, on the other hand, contain an intelligent controller on the card which performs the same Flash management functions transparent to the user.

The unique hardware implementation that SanDisk has developed and patented is many times faster, far more reliable and without any performance related issues when compared to the hardware/software solution its competitors offer. Furthermore, the competition's flash cards will operate only on computers which have the same software vendor's flash file system installed as the host system on which the flash card was originally used. This is because you cannot mix and match flash filing system software from different vendors. By contrast, SanDisk's family of Flash cards can be used interoperably between any computer which supports the PC Card ATA standard regardless of which host CPU or which operating system is employed.

Another very important difference between SanDisk FlashDisks and competing products is that competitors' Flash memory chips are designed to mimic the EPROM memory architecture and use a very large block size (64 - 4 KBytes). By contrast, SanDisk's Flash memory chips are designed to mimic the file structure of a disk drive and use the same 512 Byte sector size employed in all PC hard disk drives. This architectural difference makes the SanDisk cards 100% compatible with all MS-DOS applications and utility software. The performance of some competitors flash memory cards also varies inversely with the amount of data stored on the card, i.e., the larger the amount of data stored on the card, the slower the operating speed of the card.

Q

How can I get even higher performance from the FlashDisk?

A

You can get even higher performance from the FlashDisk by using the Erase Sectors and Write without Erase Commands. The Erase Sectors and Write without Erase commands provide the capability to substantially increase the write performance of the FlashDisk. Once a sector has been erased using the Erase Sectors command a write to that sector will be much faster. An example of where these commands may be useful is a digital camera. In this case the camera user may have plenty of time to erase pictures but may wish to take several pictures in rapid succession. To accomplish this the host system (i.e., camera) would use the Erase Sectors command to pre-erase the sectors that will store the pictures. When the pictures are taken the camera can store them in the previously erased sectors much faster than in "normal" sectors.

Many systems that can read and write FlashDisk cards may not be aware of the Erase Sectors and Write without Erase Commands. These systems would not issue these commands but such a system might attempt a normal write or a normal read to a pre-erased sector. A normal write to a pre-erased sector will function correctly, but will be at the normal write speed that is slower than a Write without Erase command. If a normal read is attempted to a "pre-erased" sector the FlashDisk will detect it is pre-erased and will return zero data and will not report an error even though the data ECC is not valid. If an "un-aware" host system over-writes a pre-erased sector with a normal write and then the card is moved to the system that created the erased sectors a situation exists where a Write without Erase might be attempted to a "normal" sector. If this occurs the FlashDisk will perform a normal write which means it will first erase the sector and then do a full write with all margin modes enabled. This write will of course be slower than if the sector were in fact pre-erased.

The advantage of the Write without Erase and Erase Sector commands is that they shift the bulk of the erase and write time to the Erase Sector command. The Erase Sector command performs most of the normal tasks needed.

Q

How is SanDisk positioned to succeed in the PCMCIA market?

A

SanDisk is strongly positioned to be a long-term, dominant force in the PCMCIA market because its advanced proprietary technology will enable the company to manufacture the highest performance and highest capacity flash mass storage cards on the market for many years. SanDisk's new CompactFlash Series, the world's smallest removable Flash mass storage, adds significant functionality to existing consumer electronics products such as digital cameras, cellular phones, personal digital assistants (PDAs), pagers, voice recorders, embedded computers, ruggedized handheld computers, etc., and enables these products to be smaller, lighter and less expensive. The very low power requirements of SanDisk's Type II and Type III PCMCIA FlashDisk Series make it the "card of choice" for the many end users who require long battery life on their PDAs, personal communicators and notebook computers. The extremely light weight, low profile, IDE FlashDrive Series are designed for mobile computing and embedded systems that require low power, high shock and vibration resistance, instant access to data, and full compatibility with rotating drives. The company's Flash products are interoperable and interchangeable among various platforms affording users a great deal of flexibility. Additionally, SanDisk achieves high reliability and data integrity in the harsh operating environment of the mobile world because it has developed an integrated intelligent controller which is included on each SanDisk FlashDisk card.

Q

Is a part number cross-reference guide available?

A

Yes! The following cross-reference guide highlights the various vendors selling the SanDisk FlashDisk technology. The cross-reference guide shown below cross references the actual PC Card part numbers only. Each vendor may have a slight variation of the part number listed to designate additional items, such as Stacker Data Compression software, End User Manual, etc. that are included in their product offerings. Ask your retailer or call SanDisk today for any assistance you require.

	SanDisk	Seagate	Verbatim	3M
1.8MB	SDP5A-1.8	ST71P5	—	1.8
2.5MB	SDP5A-2.5	ST72P5	—	2.5
5MB	SDP5A-5	ST75P5	89759	5
10MB	SDP5A-10	ST710P5	89760	10
20MB	SDP5A-20	ST720P5	89761	20
40MB	SDP5A-40	ST740P5	090665	40

Q **How can I order SanDisk products?**

A SanDisk FlashDisk products are available and shipping today in high volume quantities from a number of industry-leading OEMs and distributors around the world. Please call SanDisk today at (408) 562-0595 for the name of the supplier nearest you.

Index

Symbols

- 3.3 Volt Standard 14
- 3.3/5.0 Specification 14
- 32-bit Standard 14

A

- Advantages 22
- Architecture 14
  - CardBus 14
  - Card Hardware 15
  - Card Metaformat 15
  - Card Services 16
  - Clients 17
  - Socket Hardware 15
  - Socket Services 16

B

- Bootability 21

C

- CardBus 14
- Card Metaformat 15
- Card Services 16
- Characteristics 7
  - Compatibility 7, 11
  - High Performance 7, 9
  - Host Independence 7, 8
  - Hot Swapping 7, 10
  - Interoperability 7, 11
  - Low Power 7, 11
  - Removability 7, 10
  - Small Size 7, 9
  - User Installable 7, 8
- Client Device Drivers 17
- Commercial Acceptance 12

CompactFlash Series 23, 24
Compatibility 7, 11
Cross Reference Guide 28

D

Difference 25

E

Ease of Use 5
Environment 3
Erase Sectors command 26
Execute in Place (XIP) 20
Extender Cards 6
    Type I 6
    Type II 6

F

FlashDisk 23
FlashDrive 23
Flash Mass Storage 22
    Advantages 22
    Static RAM 22
    SanDisk 23
        Products 23
    Types 25
Future 13

G

Goal 2

H

Hardware 14
Hardware Standard 3
High Performance 7, 9
Higher Performance 26
Host Independence 7, 8
Hot Swapping 7, 10

I

- IDE FlashDrive Series 23
- Importance 12
- Interoperability 7, 11

J

- JEIDA 3, 4

L

- Layers 14, 17, 19
- Logo 4
- Low Power 7, 11

M

- Market Position 27

N

- Necessity 2

P

- PC Card 1
  - Architecture 14
    - CardBus 14
    - Card Hardware 15
    - Card Metaformat 15
    - Card Services 16
    - Clients 17
    - Socket Hardware 15
    - Socket Services 16
  - Ease of Use 5
  - Extended Cards 6
    - Type I 6
    - Type II 6
  - Logo 4
  - Types 5
    - Type I 5, 6
    - Type II 5, 6
    - Type III 5, 6

- PCMCIA 1
  - 3.3 Volt Standard 14
  - 32-bit Standard 14
  - Characteristics 7
    - Compatibility 7, 11
    - High Performance 7, 9
    - Host Independence 7, 8
    - Hot Swapping 7, 10
    - Interoperability 7, 11
    - Low Power 7, 11
    - Removability 7, 10
    - Small Size 7, 9
    - User Installable 7, 8
  - Commercial Acceptance 12
  - FlashDrive Series 23
  - Future 13
  - Goal 2
  - Hardware Standard 3
  - Importance 12
  - JEIDA 3, 4
  - Necessity 2
  - PC Card 1
  - Releases
    - 1.0 6
    - 2.0 6, 13
    - 2.01 6
    - 2.1 6, 14
  - Software Standard 3
  - What is 1
- PCMCIA-ATA 20
  - Bootability 21
  - System Software Companies 21
  - What is 20
- Pre-Erase 26, 27
- Product Operation 24
- Products 23
  - Ordering 29

R

- Release
  - 1.0 6
  - 2.0 6, 13
  - 2.01 6
  - 2.1 6, 14
- Removability 7, 10

S

- Small Size 7, 9
- Socket Services 16
- Software Standard 3
- SRAM 22
- Static RAM 22
- SanDisk 23
  - Difference 25
  - Market Position 27
  - Ordering 28, 29
  - Product Operation 24
  - Products 23
  - The Company 23
- System Software Companies 21

T

- Type I 5, 6
- Type II 5, 6
- Type III 5, 6

U

- User Installable 7, 8

W

- What is a PC Card 3
- What is PCMCIA 1
- What is PCMCIA-ATA 20
- Who is SanDisk 23
- Why is PCMCIA so important 12
- Write without Erase command 26

X

XIP 20
XT/AT bus 13

SanDisk™
3270 Jay Street Santa Clara, CA 95054   408-562-0500

2nd Edition
SanDisk PCMCIA & FlashDisk Sales Reference
Manual Lit. # 80-36-00056 Rev 0.1 02/96

© 1993/1994/1995 SANDISK CORPORATION. SANDISK is a trademark of SANDISK CORPORATION. All rights reserved. No part of this manual may be copied, photocopied, reproduced, translated or reduced to any electronic medium or machine-readable form without SANDISK's prior written approval. Information within this document was obtained from a number of industry sources. All other brand and product names are trademarks of their respective holders.

SanDisk™
3270 Jay Street Santa Clara, CA 95054
408-562-0500

Preface

The document you hold in your hand is the result of hours of effort by some of today's leading professionals in the emerging PCMCIA marketplace. We have attempted to present in an all inclusive easy to read question and answer format all the various terms, acronyms and product definitions you will need to know and understand to be successful in this exciting market. The booklet is broken into four main sections — General Information, Technical Information, FlashDisk Information and an Index. Each of these sections is tabbed for quick and easy reference. Yes, there is a lot of information in this booklet, but thumb through it at your leisure, enjoy its easy to read and understand format, and you too will become a PCMCIA superstar!

SanDisk™

3270 Jay Street Santa Clara, CA 95054   408-562-0500